the month the ground was covered with snow to the westward of a line drawn from St. Louis, Mo., to Amarillo, Tex. South and east of this line the ground was bare. In the Colorado area the snowfall on the eastern and southern slopes of the mountains was below the normal; however, the average depth on the ground at the close of the month over the Arkansas watershed, at an elevation of 9,600 feet, was 16 inches, which is 4 inches greater than on the same date in 1910. Temperature conditions have been unfavorable to melting or settling. The snow, however, is generally well packed, owing to the high winds which have prevailed. Much of the old snow is frozen and is in condition to remain after later falls have melted. In New Mexico deep snow occurred over most of the Canadian watershed; however, the amounts were greatest over the plateau and eastern portions of the Plains region. The depth of stored snow over the Sangre de Cristo, Cimarron, and Raton Ranges is generally small, and conditions are not favorable for a good supply of irrigation water for the next season, although the outlook is somewhat better than at the same time last year. Generally speaking, the snowfall conditions in the mountains are unsatisfactory.

RIVERS.

All rivers in the Kansas area remained low.

In Oklahoma all streams rose steadily during the month, but there has been no high water.

The Arkansas River in Arkansas was low during the first decade, but rose steadily at Little Rock from a stage of 1 foot on the 8th to 7.5 feet on the 31st. After the 11th the stage was satisfactory for transportation interests.

The upper White was low during the first 8 or 10 days, but moderate stages prevailed the remainder of the month.

The lower White at Clarendon fell from 13.2 feet on the 1st to 11.5 feet on the 8th, but rose steadily from the 9th to the close of the month, the highest stage recorded, 23.7 feet, occurring on the 31st.

Heavy to excessive rains in the northern portion of Mississippi caused high water in the upper Yazoo delta, and at the close of the month the Yazoo River, at Swan Lake, was several feet above the flood stage.

Moderate stages prevailed in the Mississippi River generally, and there was quite a general fall during the first 14 days. After the 14th, however, the river began rising, and the highest stages of the month were recorded at practically all points on the 31st.

TWO YEARS OF LOW WATER IN THE ARKANSAS RIVER.

By H. F. ALCIATORE, Section Director, Little Rock, Ark.

The calendar years 1910 and 1911 were record breaking years in the history of the Arkansas River. At Little Rock, Ark., 174 miles from the mouth of the river, where river records have been kept by the United States Weather Bureau office since 1879, low-water records were broken in 6 of the 12 months of 1910 and during 5 months of 1911. The gage at the place is of the standard Weather Bureau brass gage type, and is fastened to the south side of Pier No. 1 of the free bridge at the foot of Main Street. The elevation of its zero above mean sea level is 222.7 feet, and the flood stage is 23 feet. Prior to 1910 the lowest stage of the river recorded in any month since 1879 was 0.3 foot, on October 24–29, 1909. On December 6, 1910, the river fell to a stage of 0.9 foot below zero and continued at that low level for 16 days, thus establishing a new low-water record at Little Rock.

A comparison of the 1910–11 river data with those of the preceding 31 years has disclosed a number of interesting facts. In 1910 the monthly average stages were below the 10-year normal from January to December, and similar conditions prevailed during 10 of the 12 months of 1911, the exceptions being August and September. In the table below are given the highest, lowest, and average stages, and departures from normal, for 1910 and 1911.

YEAR 1910.

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Highest..	11.4	5.4	7.0	12.9	14.2	12.0	7.2	6.0	5.7	7.5	0.0	2.0
Lowest..	3.2	2.3	2.0	1.7	2.0	3.4	1.4	1.7	0.9	0.0	[1] 0.7	[1] 0.9
Average (month)	5.7	3.6	4.0	7.2	7.3	7.2	3.7	4.1	2.6	2.0	[1] 0.4	[1] 0.6
Departures...	−1.1	−3.3	−6.5	−2.2	−4.8	−4.4	−4.8	−2.1	−2.4	−2.7	−5.5	−6.4

YEAR 1911.

Highest..	2.1	8.8	7.1	14.4	9.0	6.3	8.5	18.5	8.5	5.3	2.5	8.0
Lowest..	[1] 0.3	[1] 0.3	2.0	2.0	1.5	0.3	[1] 0.5	4.3	4.5	0.8	0.3	1.0
Average (month)	0.1	2.3	3.9	8.8	3.8	1.9	1.7	8.8	5.8	2.5	0.8	4.5
Departures...	−6.7	−4.6	−6.6	−0.6	−8.3	−9.7	−6.8	+2.6	+0.8	−2.2	−4.3	−1.3

[1] Below zero.

Following are the new low-water records made during the years 1910 and 1911, with the dates on which the several records were broken:

1911. January 23–29, −0.3 foot (below zero).
1911. February 2–7, −0.3 foot (below zero).
1910. March 30–31, 2.0 feet.
1910. April 1, 1.7 feet.
1911. May 24, 1.5 feet.
1911. June 27–29, 0.3 foot.
1911. July 18, −0.5 foot (below zero).
1910. October 31, 0.0 foot (zero).
1910. November 25–30, −0.7 foot (below zero).
1910. December 6–22, −0.9 foot (below zero).

It will be seen that the only low-water records that have not been changed are those for August and September, namely, August 30–31, 1909, stage 1.4 feet, and September 30, 1879, stage, 0.6 foot.

Between Little Rock and Dardanelle periods of "no navigation" are periods during which the stages of the river are below 3.6 feet. In this regard the records show that in 1910 there were 195 days with stages below 3.6 feet, and in 1911 there were 199 such days, the record made in 1911 having equaled the record of 1879. Next in order are the year 1887, with 184 days, and the years 1880 and 1901, each with 176 days of "no navigation." In the following table the number of days with stages below 3.6 feet is given for each month of 1910 and 1911.

Number of days of "no navigation."

	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1910.....	7	17	14	4	11	3	17	12	23	26	30	31	195
1911.....	31	19	13	4	17	24	25	0	0	25	30	11	199

The above table shows that anomalous conditions have prevailed at Little Rock during the years under discussion. For instance, in May, 1911, there were 17 days of "no navigation." This is the month which, as a rule,

has the highest average stage. In August and September of the same year, on the other hand, the river was navigable during the entire month. Again, in November and December, 1910, and in January and November, 1911, navigation was suspended throughout, a very unusual state of affairs for those periods of the year. As a rule, October is the month of lowest water, but in 1910 and 1911 the river was navigable during the greater part of the month.

The remarkably low stages in the Arkansas River noted above were caused by a marked deficiency in precipitation during certain portions of the years 1910 and 1911 over the 148,241 square miles of territory comprising the drainage basin of the Arkansas River above Little Rock.

In this connection the following extracts from the "Report Upon the improvement of rivers and harbors in the Little Rock district," by Maj. Clarke S. Smith, Corps of Engineers (Appendix W, Annual Report of the Chief of Engineers, 1911), are of interest.

Arkansas River, Ark.—In its original condition the channel of the river was greatly obstructed by shifting sand bars and numerous snags in its lower reaches, and by gravel and rock shoals and some snags in its upper reaches. Navigation was difficult and uncertain at medium and low stages, and during periods of extreme low water was impossible. * * * The operations for this fiscal year (1911) were for maintenance and consisted in operating snag boats between the mouth of the river and Atkinsons, 209 miles, and in restoring to its original grade line 13,540 feet of levee opposite Pine Bluff. By the operation of the snag boats 2,668 snags were removed from the channel, 14,418 trees were cut on caving banks, and three drifts broken. At the close of the fiscal year the channel of the river in the upper reaches above Little Rock is in fine condition so far as snags and similar obstructions are concerned. In the lower river there are many obstructions of that nature. * * * The periods of navigation by steamboats are of about the following averages:

	Months a year.	
	For 4-foot draft.	2-foot.
Arkansas River:		
From mouth to Swan Lake (90 miles)	5½	10
From mouth to Little Rock (174 miles)	5	9½
From mouth to Grand River (461 miles)	4	8

The river in the vicinity of Little Rock has been lower in gage heights this fiscal year than ever before since the establishment there of a river gage in 1871.

* * * Since the period of heavy crop movement occurs at the same time as the lowest water period, this condition has made the quantity of plantation products moved this year less than in any year of which record has been kept. There was a slight increase in quantity of forest products moved. Plantation products and supplies made up 20 per cent, and forest products 70 per cent of the commerce of the year; the remaining 10 per cent being of general merchandise and unclassified freights. It does not appear that the improvement of the river in late years has had any marked effect on intrastate freight rates, either by water or by rail.